

Analysis of NDVI variance across landscapes and seasons allows assessment of degradation and resilience to shocks in Mediterranean dry ecosystems

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Mapping and assessment of desertification is a primary basis for effective management of dryland ecosystems. Vegetation cover and biomass density are key elements for the ecological functioning of dry ecosystem, and at the same time an effective indicator of desertification, land degradation and sustainable land management.

The Normalized Difference Vegetation Index (NDVI) is widely used to estimate the vegetation density and cover. However, the reflectance of vegetation and thus the NDVI values are influenced by several factors such as type of canopy, type of land use and seasonality. For example low NDVI values could be associated to a degraded forest, to a healthy forest under dry climatic condition, to an area used as pasture, or to an area managed to reduce the fuel load.

We propose a simple method to analyse the variance of NDVI signal considering the main factors that shape the vegetation. This variance analysis enables us to detect and categorize degradation in a much more precise way than simple NDVI analysis. The methodology comprises identifying homogeneous landscape areas in terms of aspect, slope, land use and disturbance regime (if relevant). Secondly, the NDVI is calculated from Landsat multispectral images and the vegetation potential for each landscape is determined based on the percentile (highest 10% value). Thirdly, the difference between the NDVI value of each pixel and the potential is used to establish degradation categories .

Through this methodology, we are able to identify realistic objectives for restoration, allowing a targeted choice of management options for degraded areas. For example, afforestation would only be done in areas that show potential for forest growth. Moreover, we can measure the effectiveness of management practices in terms of vegetation growth across different landscapes and conditions.

Additionally, the same methodology can be applied to a time series of multispectral images, allowing detection and quantification of resilience to e.g. climatic oscillations or fires, and to monitor recovery after such disturbances (i.e. vegetation growth after wildfire)